Reminiscences on the University of Michigan Summer Schools, the Gatlinburg Symposia, and *Numerische Mathematik*

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1. The University of Michigan Summer Schools

These summer schools were ably directed in the early 1960s by Professor Robert Bartels (emeritus) of the University of Michigan. Bartels brought in people such as Golub, Henrici, Householder, Taussky, Todd, Varga, Young, and Wilkinson to give intensive lectures of one or two weeks in duration at the University of Michigan. This gave interested people from both industrial and academic life the possibility to come and learn firsthand about the new (and flowering) area of numerical analysis from leading experts in the field. There are several things worth mentioning about this summer school experience:

☐ There was the learning experience of hearing, firsthand, lectures on material that would become the well-known books in numerical analysis. This was, in a certain sense, a proving ground for the books of Henrici, Householder, Varga, Todd, and Wilkinson.

☐ There was the fellowship of eating with the gang at the Old German Restaurant in Ann Arbor. Here the indentations of pitchers of dark beer produced interesting Gerschgorin circles on table cloths! It was a friendly group, and it has remained over the years a very friendly group.

☐ There were evening seminars in which the day's lecturers presented seminars, just for this select group, on their current research. For example, there were many fine lectures by Jim Wilkinson, and participants could see on a first hand basis the development of his research on eigenvalue problems.

It is important to note that this was an exciting learning process for *all* of us, in that we were filling in necessary mathematical backgrounds and learning new tools. This should come as no surprise, since none of the lecturers (save Gene Golub and David Young) actually wrote theses in numerical analysis. We were, in fact, being converted, via these lectures and seminars, to practitioners in numerical analysis, even though we had come from training in analysis (such as my own training) or linear algebra. It was indeed a wonderful way to learn

more about this new field of numerical analysis, and we sincerely thank Bob Bartels for this great opportunity to learn from the masters.

2. The Gatlinburg Symposia on Numerical Linear Algebra

It is impossible to give a truly unbiased and unemotional description of the impact of one's first Gatlinburg meeting. This is because the meetings were specialized, current, and attended by the world's leaders. Because these meetings were relatively small (usually fewer than 100 people), it meant that one could talk shop with the greats in the field. My first Gatlinburg Symposium was in 1961, and I can recall with pleasure meeting so many European numerical analysts for the first time.

Initially these symposia were structured so that there were *no* invited lecturers. All came with the idea of sharing new ideas, results, tools, references, and so forth. As the spirit so moved us, talks somehow materialized. (There was a committee, however, to help "prompt" people to offer to give "spontaneous" lectures.)

I won't speak for others, but my first Gatlinburg Symposium, in 1961, had to be one of the best conferences I ever attended. There was a magic feeling of a "happening" at this meeting, with so many provocative and stimulating lectures and open research problems.

One aspect to these Gatlinburg Symposia certainly has changed, at least for me. Because numerical analysis was in its infancy when these Gatlinburg Symposia began, I believe I was personally able to understand *all* the lectures that were given, from linear algebra, O.D.E.s, P.D.E.s, to graph theory. This, alas, is no longer the case, and I don't think this has to do with my declining abilities. Numerical analysis has grown rapidly, and in many diffuse directions; it is a maturing discipline, after all. It now takes a local expert to understand lectures on the cutting edge of research in many subdivisions of numerical analysis. For example, the last few Gatlinburg Symposia have had great lectures on robust software construction (such as EIS-PACK) at one end of the numerical analysis spectrum and on deep problems in what has to be called applied functional analysis dealing with Sobolev spaces and application to finite elements at the other end. This growth in numerical analysis makes it increasingly difficult to be a "renaissance man" today in all areas of numerical analysis, and this means, unavoidably, that certain subgroups of numerical analysts have greater difficulty in communicating with each other.

It is important to remark that these Gatlinburg Symposia were first-rate meetings, with first-rate people in attendance and first-rate lectures. I believe we owe a special vote of thanks to Alston Householder for creating these meetings and for organizing and executing

the first few meetings. The structure of these meetings was such that there was always plenty of time for in-depth informal discussions between interested parties. Also, there was a fever-pitch level of stimulation about these meetings. I can vividly recall sitting in the back seat of a VW Beetle owned and driven by W. Kahan. On one outing to the Smoky Mountains, Fy Fan and Kahan were seated in front, and Mrs. Kahan and I were in the rear. On the way back to our hotel, on a winding and particularly steep road, the two gentlemen in the front began to argue loudly and almost physically about some fine point in mathematics. I really didn't enter the fray—I was too worried about an accident! But I do recall Mrs. Kahan saying to me, after Velvel (Kahan) had given a rather long rebuttal, "Isn't he just brilliant?" Yes, he *is* brilliant.

It should also be mentioned that the Gatlinburg Symposia were originally designed to be "closed" meetings but that there has been growning concern and dislike by many about this particular nature of these Gatlinburg Symposia. The reason for closed meetings was simply to limit the number of participants to about 100, so as to ensure that participants really could interact with one another. (This is still the way that the Oberwolfach meetings in the Black Forest of Germany are carried out, for example, even after 40 years.) This is in contrast with the large, open, annual meetings of the American Mathematical Society and the SIAM meetings, which attract thousands of participants.

The Gatlinburg 10 Symposium was held 19–23 October 1987 at the Fairfield Glade in Tennessee. The idea was to bring these Gatlinburg Symposia back to the United States, where they started. It would have

TABLE 1
The Gatlinburg Symposia

Year	Number	Place Held	Organizer
1951	−1	Los Angeles	O. Taussky
1957	0	Detroit	W. Givens
1959	1	Gatlinburg	A. S. Householder
1961	2	"	"
1965	3	"	"
1969	4	"	"
1972	5	Los Alamos	R. S. Varga
1974	6	Hopfen am See	F. L. Bauer
1977	7	Monterey	G. H. Golub
1981	8	Oxford	J. Wilkinson/ L. Fox
1984	9	Waterloo	Alan George
1987	10	Fairfield Glade	G. W. Stewart

been nice to have gone back to the original site of Gatlinburg, but Gatlinburg, once a quiet and peaceful resort area, is now reported to be loud and commercial. The Gatlinburg 10 meeting was an open meeting, but each person wishing to participate was requested to submit a short abstract of his or her research and interests. Things *do* change.

In Table 1, we list all the Gatlinburg Symposia, along with the persons responsible for organizing and executing them. We remark that the Gatlinburg Symposia were influenced in part by the existence of two earlier and similar symposia, the first organized by Olga Taussky in 1951 and the second by Wallace Givens in 1957. These earlier symposia have often been referred to as Gatlinburg Symposia −1 and 0.

3. The *Numerische Mathematik* Connection

The first volume of *Numerische Mathematik* (NM) was published by Springer-Verlag in 1959, with founding editors A. S. Householder, R. Sauer, E. Stiefel, J. Todd, and A. Walter. (You may know that we celebrated the 25th anniversary with a meeting in Munich in 1984.) Since this first volume, there have been 35 volumes of *NM* through 1981 (roughly $1\frac{1}{2}$ volumes per year), with each volume having approximately 450 pages of research.

Each issue of *NM* has contained the following unchanging description of the role to be played by this journal:

> The journal "Numerische Mathematik" provides for the international dissemination of contributions dealing with the general problems of digital computation. Such contributions may include discussions of existing numerical techniques as well as the development of new ones, but preferably with reference to the application of these techniques to programming for automatic computation.

But the truth of the matter is that *NM* has had a much more selective and specific role as a technical journal, as its self-description might have read:

> The journal "Numerische Mathematik" is dedicated to the international dissemination of outstanding contributions dealing with the theory and applications of numerical mathematics. Such theory and applications are included in finite elements and their applications, iterative and direct methods for matrix equations, spline functions and their applications, linear and nonlinear optimization methods, linear algebra, and numerical methods for ODEs and PDEs.

The rejection rate for papers submitted to *Numerische Mathematik* has remained over the years at about $\frac{1}{3}$. As George Forsythe in his infinite wisdom once said, "A journal is only about as good as the manuscripts it receives!" This remains true today for all journals.

It might be a good idea to recall the original main editors of *NM*, to show the changes over the years. These were the founding editors:

>1959–1966: Householder, Sauer, Stiefel, Todd, Walter

Then, K. Samelson, F. L. Bauer, and J.H. Wilkinson were added as main editors in 1967, with the death of Professor R. Sauer and with the resignation of Professor A. Walter.

>1967–1971: Bauer, Householder, Samelson, Stiefel, Todd, Wilkinson

R. S. Varga was added in 1972:

>1972–1976: Bauer, Householder, Samelson, Stiefel, Todd, Varga, Wilkinson

Then, G. H. Golub was added in 1977:

>1977–1979: Bauer, Golub, Householder, Samelson, Stiefel, Todd, Varga, Wilkinson

J. Stoer replaced E. Stiefel in 1979 after Stiefel's death:

>1980: Bauer, Golub, Householder, Samelson, Stoer, Todd, Varga, Wilkinson

Then, K. Samelson died in 1980:

>1981: Bauer, Golub, Householder, Stoer, Todd, Varga, Wilkinson

A quantum change came in 1981 with the addition of R. Bulirsch, H. B. Keller, G. W. Stewart, and C. Zenger:

>1981–1986: Bauer, Bulirsch, Golub, Householder, Keller, Stewart, Stoer, Todd, Varga, Wilkinson, Zenger

With the untimely death in 1986 of J. H. Wilkinson, the main editors of *Numerische Mathematik* numbered 10. Finally in 1988, I. Babuška, P. Ciarlet, and B. Parlett were added:

>1981–1986: Babuška, Bauer, Bulirsch, Ciarlet, Golub, Householder, Keller, Parlett, Stewart, Stoer, Todd, Varga, Zenger

Although I have dwelt on the main editors of *NM*, who were perhaps the guiding spirit behind *NM*, there are now 30 associate editors also, many of them in the audience. Without a doubt, they too have contributed very much to the success and vitality of *NM*.